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METHODOLOGY

Exploring the use and impact of LCA-based information in corporate communications

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Abstract
Background, aim, and scope The effective communication of corporate environmental messages has a history of mixed results and concerns remain around the quality and accurateness of these messages. Life cycle assessment (LCA) information is often presented as a promising informational tool, by which improved communication effectiveness of environmental/sustainable claims may materialize; however, the possibility of information overload has limited its application in marketing communication settings. The overall purpose of this research is to better understand how LCA-based environmental performance information might be effectively communicated in an advertising setting, the impact of such messages on individuals' attitudes and behavioral intentions, and the mediating roles of informational complexity and credibility.
Methods Fictitious, but realistic, advertisements employing LCA-based information were created and tested empirically in two experimental settings. The first, in a business-to-consumer (B2C) setting, examines the influence of several environmental information contents, formats, and disclosures on attitudinal factors toward the ad, brand, and company, as well as behavioral intentions. Using hair shampoo as the product category, and the biodegradability capacity of its bottle as the environmental attribute, regression analyses were developed based on a sample of 3,292 subjects evaluating one of 12 different advertisements. The second experiment presented in this paper expands upon these ideas by focusing on a business-to-business (B2B) environment where the need for cognition, and thus the complexity threshold, is thought to be quite high and where environmental performance is expected to be of importance to the purchaser. This experimental setting includes responses from 1,062 architects and engineers—all of whom are members of the U.S. Green Building Council who evaluated one of eight different advertisements. In this experimental setting, the volume of LCA-based information is varied, while exploring the role of this information in conjunction with functional product performance messages.
Results Results indicate that LCA-based information can be effective within an advertising medium in enhancing message credibility, attitudes toward the brand and company, and positively influencing behavioral intentions toward purchasing, even though this information is viewed as complex and detrimental to attitudes toward the advertisement itself. More specifically, results from the first empirical experiment indicate that LCA-based communications make for more poorly reviewed advertising, but the credibility gained through explicit LCA-based environmental disclosures favorably influences the perceptions toward the company and the brand. These results are confirmed in the business-to-business experiment. Evidence from this study suggests that, within environmentally aware and sensitive recipients, advertisements with environmental messages are more effective than those presenting functional product benefits alone, but only when the messages are substantiated with elaborated LCA-based information.
Discussion Within the B2C respondents, we found that the perceived complexity of the ad in fact generated a significantly positive attitudinal response concerning the company

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under evaluation, which was not evident in the B2B study. The results suggest that the end-use consumers in the first experiment more often processed the ad through the peripheral route of persuasion, where the downside risk of presenting complex and detailed environmental information is significant (i.e. people won't pay attention to the ad), but can be balanced (or even surpassed) by positive associations with presenting additional information (i.e. the company must be strong if it is willing to fully disclose all of this information).

Conclusions The influence of perceived complexity of LCA-based advertisements does not appear to negatively influence most measures typically used to assess advertising effectiveness; however, the appeal of the advertisement itself is significantly negatively impacted by increases in complexity. The credibility gained through more elaborated LCA-based environmental messages, to a high extent, compensates the effect of complexity on the attitude toward the appeal of the ad itself. In fact, this credibility strongly influences in a positive manner the attitudes buyers have toward the ad, the brand, the company, and their intention to purchase the product under evaluation.

Recommendations and perspectives Practitioners are to reconsider the position that simple and appealing advertisements are most effective to an overall marketing communication strategy addressing environmental performance. Simple messages are often required to gain market awareness and break through the noisy hypermedia marketplace; however, our results suggest that a firm's ability to gain credibility in its message can compensate for many of the negative effects of highly complex messages. Researchers and LCA professionals influencing methodologies and implementation of LCA at the product level should recognize the potential use of selected and incomplete LCA-based information by firms in marketing communications. While strategic differentiation benefits associated with effective communication of environmental performance may lead to increased use of LCA techniques by firms, appropriate development of standards and certifications may be required to preserve perceptions of objectivity and transparency associated with LCA methodologies.

Keywords Advertising · Business-to-business (B2B) · Business-to-consumer (B2C) · Communications · Information complexity · Information credibility · LCA information · Marketing · Product environmental performance

1 Background, aim, and scope

Over the past two decades, the connection among information, consumer behavior, and the environment has received significant attention. There is a growing interest in the role that information and labeling have in the encouragement of environmentally preferable products. Governments and non-governmental organizations have increasingly turned to firm-level information disclosure as another policy tool in addition to, or in lieu of, traditional command-and-control regulations. Embraced in the recently developed Integrated Product Policy concept (Oosterhuis et al. 1996; Ernst and Young/SPRU 1998), this approach focuses on improving the environmental performance of products in a long-term strategy that requires continuous learning and collaboration among policy-makers, civil society, business, consumers, and other stakeholders. Similar 'extended product responsibility' policies are also emerging in the USA, initiated by both the private and public sectors, in the form of certifications and State regulations (Hickle 2007). This concept integrates public policy, life-cycle, and communication frameworks as its leading principles pivotal to informing consumers of the environmental performance associated with the products they buy. Nevertheless, the implications of information disclosures in this process are by no means well understood and the ultimate objective of promoting sustainable patterns of consumption remains to be seen.

Voluntary market-driven tools like third-party certifications, eco-labels, and environmental product declarations have fueled demand for increased environmental performance information of products. Product labeling systems, such as the Blue Angel in Germany, Japan's Eco-Mark, and Energy Star in the USA, among the many others, help inform consumers of environmental impacts associated with the products they buy. It is believed that certifications, conducted by third-parties specifically, aid organizations in conveying more trustworthy messages; however, rapid growth in certification schemes within and across product categories, variation between the award criteria of schemes, differences in the methods used to determine environmental performance, difficulty in assessing the degree of autonomy between certifying bodies and the companies or products being certified, and lack of sufficient market awareness of certifications and labels have been forwarded as potential barriers to success (Truffer et al. 2001; Molina-Murillo and Smith 2005). Environmental Product Declarations, based on the ISO standard 14025: 'Environmental labels and declarations-Type III environmental declarations-Principles and procedures', address many of the problems encountered by the more common third-party certifications (ISO Type I labels), and they have been further analyzed in several different product categories (Del Borghi et al. 2007; Schau and Fet 2008; Mungkung et al. 2006). In addition to enabling purchasers, particularly in business-to business (B2B) settings, to make more complete and objective comparisons of environmental performance between products, it is also believed that the process of searching for life

cycle information can build new relationships among actors in the supply chain to design, manufacture, market and distribute, reclaim, recycle, re-use, or dispose of products in a less impactful way (Fet and Starr 2006; Pujari et al. 2004). Furthermore, experts are anticipating that LCA-based information will be fundamental to provide consumers with information supportive of more sustainable patterns of consumption (Loerincik et al. 2005). While companies across many sectors (e.g. cars, building materials, fuels, detergents, and electronics) are optimistic about the use of LCA to support their business and believe that the use of LCA will increase in the future (Frankl and Rubik 1999), adoption of EDPs and other LCA-based communications—particularly outside of obscure web sites—has been slow (Frankl et al. 2007).

Companies are constantly searching for new approaches to differentiate themselves in order to compete in the market place (Schmalensee 1982; Porter 1985) and LCA-based information could help firms better communicate superior environmental performance. In this regard, advertising is a likely means by which companies communicate to customers' brand superiority (Tellis 2005). Environmental advertising, however, has a history of mixed results at best and multiple concerns have been raised around vague, incomplete, biased, and exaggerated environmental claims (Prothero 1990; Carlson et al. 1996; Karna et al. 2001). LCA-based information disclosures are thought to provide consumers with useful, and in many cases, more objective assessments of the environmental performance of products and the firms manufacturing them. However, this approach creates a new set of implications for companies. On one hand, messages potentially carry greater credibility, generating more favorable attitudes toward communications; while on the other, messages are typically more complex requiring greater involvement from the consumer.

While attention in LCA has increased in recent years, most of the research in this topic has focused on improvements of LCA tools and methodologies, as opposed to how LCA information is processed and used by companies in the development of business strategies and marketing communication activities. In addition, there has been little investigation addressing the impacts of LCA information on both final consumers and business buyers. Thus, the overall purpose of this research is to better understand how LCA-based environmental information is communicated in advertising settings and the impact of such messages on individuals' attitudes and behavioral intentions. The overarching research problem explored in this study is: should more specific and elaborated environmental messages in advertisements be developed? In order to achieve this goal, two empirical tests are carried out. The first specifically looks at the influence of several environmental information contents, formats, and disclosures on attitudinal factors and behavioral intentions within a business-to-consumer (B2C) setting. The second experiment takes a closer look at functional product information and non-functional (environmental) product information, within a business-to-business (B2B) context. Results from multiple regression and factor analysis are presented. We, then, elaborate on key findings and conclusions, and finally, provide recommendations and perspectives to practitioners and researchers.

2 Toward a framework of communicating LCA-based information

Providing trustworthy environmental (green) information to consumers and buyers in order to assist them in making informed purchase decisions has not always been the case in practice (Kangun et al. 1991) and environmental advertising has in some instances come to represent more of a liability than a benefit (Easterling et al. 1996). Solving this problem is much easier said than done. First, environmental issues are themselves complex and require significant disclosures in light of many information asymmetries (Teils and Roe 2005). Second, communications from multiple stakeholders in an effort to maintain legitimacy (Frooman 1999; Harrison and St. John 1996) often provide conflicting expert information to an already crowded media marketplace (Wu and Newell 2003). Third, environmental attributes are difficult to evaluate in that they are difficult to experience directly and are not easily evaluated either before or after purchase. Finally, environmental messages, such as 'earth friendly', 'green', 'recyclable', for example, are commonly evaluated by individuals with skepticism as incomplete, misleading, or greenwashing (Kangun et al. 1991; Carlson et al. 1993; Polonsky et al. 1998; Ozanne and Vlosky 1997).

An obvious solution to this problem is providing consumers with more explicit information to elaborate upon the claim and potentially further support a functionality, benefit, or position of a product. However, as the nature of informative advertising messages becomes increasingly explicit and the number of product benefits grows, questions emerge as to the amount of information required to effectively communicate these types of information and the impact of these efforts. With regard to the effectiveness of advertising, it has been pointed out that changes in target segment, message, and particularly creative content might result in large changes in advertising effectiveness (e.g., Tellis 2005; Lodish et al. 1995). Some researchers point out that emotional and simple messages are more effective in persuading individuals to buy or change their beliefs based on the assumptions that consumers often seek to minimize their cognitive effort, have limited ability, and a low threshold for boredom

(Anderson and Jolson 1980; Shuptrine and McVicker 1981). Others, however, point out that environmental messages should not be treated in the same way as other product attributes, and that more specific, detailed, and informative claims are required to avoid misleading messages (e.g., Davis 1993, 1994; Kangun et al. 1991). Given the increased effort required to process more complex messages, some researchers have found evidence that complex messages can positively affect attitude formation and memory (Steward and Koslow 1989; Phillips 1997; Lowrey 1998).

We hypothesize that a critical aspect in the connection between environmental information disclosure and consumer/buyer attitudinal change is the influence of credibility and complexity as antecedents of communication effectiveness. While credibility based on the source of the information is beneficial in creating positive associations with a brand in the absence of technical information (Ohanian 1990; Hovland and Weiss 1951), in situations where the lack of information detail (or the ambiguity of information) leave consumers with little opportunity to make meaningful decisions, claims can be perceived as deceitful and negatively impact the product, its brand, the company and its endorser. We propose that disclosing to individuals LCA information (which is quantitative in nature, specific, transparent, etc.) will result in positive attitudes, especially towards the product and company that discloses such information—creating higher credibility, and ultimately, higher purchase intention. The mechanisms that consumers employ to process messages are illustrated in Fig. 1, whereby a framework is proposed by which complexity and credibility mediate the communication effect on attitudinal (attitude toward the ad, attitude toward the brand, attitude toward the company) and behavioral intention (purchase intent) factors. The causal relationship hypothesized among these variables has provided a better understanding of the advertising framework commonly accepted today in the marketing literature (e.g., MacKenzie and Lutz 1989; Batra and Ray 1986). Many variants of this model have been proposed over the years, all of which assume that an attitude shift is required prior to purchasing (Vaughn 1980). Attitudes toward the ad or the predisposition to respond in a favorable/unfavorable manner to a particular advertising stimulus during a specific exposure have been considered an important factor that drives attitudes toward the brand (e.g. Shimp 1981) and toward the company (e.g. Winters 1986).

3 Methodology

Two empirical tests are conducted in this research. The first specifically looks at the influence of several environmental information contents, formats, and disclosures on attitudinal factors and behavioral intentions in a business-to-consumer (B2C) setting. In the second test, we take a closer look at functional product information and non-functional (environmental) product information, within a business-to-business (B2B) context. In this second experiment, a slightly different angle was taken. Environmental performance messages,

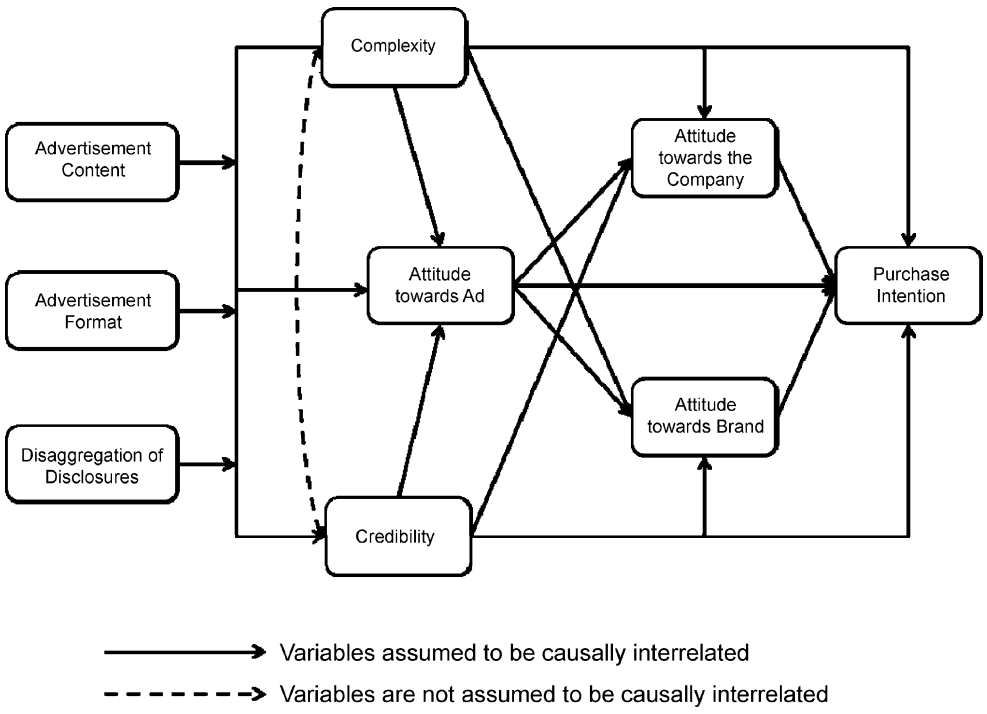

Fig. 1 Complexity and credibility influence on attitudes and behavioral intentions

which are typically considered ancillary in nature, are explored in conjunction with the central (functional) product performance message, as opposed to the environmental message presented in isolation, as has been often the case in previous research (e.g., Chan 2000).

3.1 Study 1: ad format and LCA disclosure in a business-to-consumer setting

A pretest (n=224) helped to assess and purify the measures; reliability and unidimensionality checks of pretest respondents helped to verify their appropriateness. The experimental design included variables created to address four types of formats: (1) an ad with environmental information presented without any disclosure of LCA information is used as a control and is identified as NOLCA; (2) environmental information presented as in (1), plus LCA-based information presented within the text (TEX); (3) environmental information is presented as in (1), plus LCA-based information presented in a figure-based visual format (FIG); and, (4) environmental information presented as in (1), plus LCA-based information presented in a tabular visual format (TAB). Three different levels of credibility prompts were also tested: (1) no additional information, identified as NODIS; (2) a disclosure including an independent third-party environmental certification label along with its explanatory statement as a proxy of source credibility (CER); and (3) a disclosure containing a label similar to (2) but with an explanatory statement defining the use of standardized LCA methods, as a proxy of process credibility (PRO). Our final sample was composed of junior and senior undergraduate students from a large Midwestern university in the United States and includes 3,292 respondents.[1] The mock advertisements used in this experiment are available online in Appendix 1. Following suggestions from the Dillman (2000) 'tailored design method' an explanatory email was developed asking individuals to participate in the study, housed within a separate web-based location. The ads were produced with support from an advertising/graphic designer and a fictitious brand name was created to avoid bias due to brand familiarity (Davis 1994; Brooks and Highhouse 2006). Constructs were developed primarily from previously validated multi-attribute scales. Along with the variables of interest, multiple control variables were also created, most of which employ semantic differential or bipolar scales.

[1] The original response rate was 43% resulting in a total of 4,153 responses. Participants expended in average 10.29 min (median=10) to complete the assessment, and only those within a 95% confidence interval were included in the analysis. In addition, respondents who only partially completed the questionnaire and respondents for which English is the second language were excluded. The final sample includes 42.8% males and the remaining 57.2% were females.

3.2 Study 2: disclosure of non-functional (LCA-based) information in a business-to-business setting

The methodological approach taken in this experiment is very similar to the previous test in the consumer context; therefore, we reserve our comments here to those aspects that merit further explanation. The final sample was composed of 1,062 architects and engineers[2], all members of the United States Green Building Council (USGBC). Each subject randomly received one of eight insulation advertisements. Advertisements used in this experiment can be accessed online in Appendix 2. Both, the original e-mail request and a followed reminder were directly sent by the USGBC. The ads were produced with support from an advertising/graphic designer and with significant input from the Communication Committee of the North American Insulation Manufacturing Association (NAIMA). As in the first experiment, a fictitious brand name was also employed. Three different aspects of the advertisement were modified as follows: (1) a 'general disclosure', which is associated with a functional (GFU) or an environmental performance (GEN) description of the product under evaluation; (2) 'elaborated disclosure', involving specific and quantitative statements associated with a functional (ELFU) description of the product or an environmental performance (ELEN) description based on LCA information; and (3) 'private benefit disclosure', including both an image and a textual statement of either a functional benefit (PFU), a financial benefit (PFI) or a health benefit (PHE). The baseline advertisement (1) in our experimental design was created to have only functional information, that is: a general functional disclosure (GFU) and a functional private benefit disclosure (PFU). The other ads were modified as follows: (2) this ad is as in (1) with a general environmental disclosure (GEN); Ads 3 and 4 are as in (2) with a private financial disclosure (3) or a health private disclosure (4). Ads 5 to 8 are same as the first four, but instead of general disclosures, they all contain 'elaborated disclosures'.

4 Results

In both empirical tests, a well-accepted extrapolation method was used in examining potential non-response bias

[2] The original response rate was 21.5% resulting in a total of 1,346 responses (21.5% response rate). Participants expended in average 12.22 min (median=10) to complete the assessment, and only those within a 95% confidence interval were included in the analysis. In addition, respondents who only partially completed the questionnaire and respondents for which English is the second language were excluded. The final sample includes 64.3% males and the remaining 35.7% were females.

by comparing early and late respondents (Armstrong and Overton 1977). The existence of possible non-response bias was investigated among those who responded to the questionnaire in the first request and those in the follow-up reminder. No significant differences were detected between these two groups along a number of key variables at α=0.05. Based on this analysis, concerns of non-response bias have been set aside.

4.1 Results of the study 1 in the business-to-consumer setting

4.1.1 The effects of format on complexity and credibility

Through an analysis of variance (ANOVA), it was evident that we can reject the hypothesis that the effectiveness of the four different ad formats on complexity (COM) (or credibility (CRE)) was the same. In the case of complexity, the *F*-statistic for multiple group comparisons was 20.14 with 3 degrees of freedom (df) and probability (*p*) that the means were the same of 0.001. In the case of credibility, these statistics also show that there were significant differences among the four formats analyzed (F=4.38; df=3; p=0.004). Through a test for multiple comparisons of estimated marginal means, the formats were contrasted against each other (Table 1). This test compared the credibility mean (or complexity mean) of a particular format against the mean of each of other three formats. Therefore, Table 1 shows the difference between the two means compared in each test and the asterisks indicate if such difference is significantly different either at 90% or 95% interval of confidence. As one might imagine, ads showing information in a textual form with or without LCA data (i.e. NOLCA and TEX) are viewed as less complex (COM) compared to those ads that included LCA data, either in a figure (FIG) or table (TAB) format. With regard to the effects of format on credibility (CRE), all formats were perceived similarly, with the exception of LCA data presented in a figure-based format (FIG) which is viewed as less credible than all the other formats. There are at least two explanations why this occurred. First, the quantitative data was presented with percentages only and might be perceived as too general. Second, the evident indicators themselves are around the mean, which might be visually signaling weak performance. Although the tabular format of presenting LCA information is viewed as the more complex than textual claims, they are viewed as being of similar credibility.

Table 1 Effect of format on complexity (COM) and credibility (CRE)

Format I	Format J	Complexity (COM)	Credibility (CRE)
		Mean difference (I−J)	
NOLCA	TEX	–0.100	–0.044
	FIG	–0.368*	0.153*
	TAB	–0.451*	0.012
TEX	FIG	–0.268*	0.197*
	TAB	–0.350*	0.056
FIG	TAB	0.083	–0.141**

NOLCA=advertisement does not include LCA information, *TEX*=textual format, *FIG*=figure format, *TAB*=tabular format
*p value≤0.05 (significantly different); **p value≤0.10 (significantly different)

4.1.2 The effects of disclosures on complexity and credibility

Following the same testing approach as the one described in the previous section, the effectiveness of the three different types of disclosures tested through an ANOVA have significant effects, both, on complexity (F=6.46; df=2; p=0.002) as well as on credibility (F=6.54; df=2; p=0.001). Through a test for multiple comparisons of estimated marginal means, the effects of the disclosures were contrasted against each other. This test compared the credibility mean (or complexity mean) of a particular disclosure type against the mean of each of other two disclosures. As shown in Table 2, these results suggest that disclosures related to the LCA process (PRO) were viewed as being more complex than having a certification disclosure (CER) or having no disclosure at all (NODIS). In addition, presenting information of the life cycle process (PRO) and environmental certifications (CER) helped the credibility of the ads, as compared to having no disclosure at all. The interaction effects of format and disclosures were found to be non-significant both on complexity (F=1.38 df=6; p=0.250) and on credibility (F=0.99; df=6; p=0.494). Thus, in the next section we explore how each individual format and disclosure, along with complexity and credibility may influence communication effectiveness (i.e. AAD, ABR, ACO, and PI).

Table 2 Effect of disclosures on complexity (COM) and credibility (CRE)

Disclosure I	Disclosure J	Complexity (COM)	Credibility (CRE)
		Mean difference (I−J)	
NODIS	CER	0.053	–0.180*
	PRO	–0.151*	–0.090
CER	PRO	–0.204*	0.089

NODIS=advertisement with having no disclosure at all, *CER*=certification disclosure, *PRO*=disclosure related to the LCA process
*p value≤0.05 (significantly different)

4.1.3 The effects on attitudes and purchase intentions in the B2C test

To test the hypothesis that complexity and credibility influence communication effectiveness, a series of regression analyses were used. Results summarized in Table 3 indicate that COM had a strong negative influence on AAD (–0.386; $t_{3,298}$=–33.12) and a significantly negative coefficient, albeit less strong influence on PI (–0.081; $t_{3,298}$= –5.360). ABR was not affected by COM (0.021; $t_{3,298}$= 0.132), but interestingly, advertisements viewed as significantly more complex positively influence ACO (0.022; $t_{3,298}$=2.290). These results provide support to the notion that more complex ads tend to negatively affect the individual assessment of the advertisement.

The perceived credibility (CRE) of the information presented in the ads had a significantly positive effect on all the communication effectiveness measures (i.e. AAD, ABR, ACO, and PI). The strongest effect is on AAD (0.291; $t_{3,298}$=21.043), which is consistent with the literature (e.g. MacKenzie and Lutz 1989).

4.2 Results of the study 2 in the business-to-business setting

Two key questions are addressed in the second experiment: (1) Do non-functional (environmental) messages complement or impair the functional product performance information? (2) How do LCA/elaborated claims influence the communication effectiveness of advertisements? In theory, the functional benefits of products are intended to solve more fundamental needs which require fulfillment prior to the consideration and evaluation of experiential or symbolic product benefits. Because functional benefits are by their very nature connected directly to the central consumptive problem, they have been widely considered as central in product evaluations, theoretically and empirically (Keller 1993; Park et al. 1986; Woods 1960). Nevertheless, the absence of other non-functional product performance information can lead to negative evaluations, especially in mature products or competitive situations where the functional benefits are fairly familiar (Swan and Combs 1976).

4.2.1 The effects of environmental messages on functional product information

To test whether non-functional (environmental) disclosures (EN and ELEN) improve the communication effectiveness over functional messages (FU and ELFU), several regression analyses were carried out. Results are summarized in Table 4. One important finding indicates that although mentioning environmental LCA information (EN) positively influences PI (0.172; p value=0.026), it does not improve

Table 3 Regression results of all dependent variables in the B2C study

	Standardized coefficient estimates (n=3,292)					
	COM	CRE	AAD	ABR	ACO	PI
Independent variables						
Intercept term[a]	5.267	2.670*	4.129*	2.149*	1.669*	–1.458*
LCA data—text (TEX)	0.107	0.046	–0.023	–0.059	–0.030	0.052
LCA data—figure (FIG)	5.267*	–0.151	–0.164*	–0.032	–0.030	0.156*
LCA data—table (TAB)	0.107*	–0.013	–0.103*	–0.044	–0.005	0.114*
Cert. disclosure (CER)	0.375	0.179*	0.025	0.047	0.015	0.030
Process disclosure (PRO)	0.458*	0.089**	0.014	–0.007	0.009	0.014
Complexity (COM)	–	–	–0.386*	0.021	0.022*	–0.081*
Credibility (CRE)	–	–	0.291*	0.147*	0.275*	0.242*
Attitude towards the Ad (AAD)	–	–	–	0.331*	0.097*	0.320*
Attitude towards the brand (ABR)	–	–	–	–	–	0.209*
Attitude towards the company (ACO)	–	–	–	–	–	0.150*
Control variables						
Gender (GEN)	–0.055	–0.066	0.077*	–0.187*	–0.029	–0.094*
Purchase involvement (INV)	0.160	0.009	0.020	0.022**	0.009	0.041*
Environmental concern (EC)	0.023*	0.123*	0.090*	0.038*	0.047*	0.217*
Need for cognition (NC)	0.007*	0.156*	0.015	0.007	0.028*	0.040**
Attitude towards advertising (ADV)	–0.102*	0.280*	0.064*	0.039*	0.144*	–0.007
Adj. R^2	0.057*	0.079*	0.458*	0.258*	0.341*	0.487*

*$p \leq 0.05$ (significant)
**$p \leq 0.10$ (significant)
[a] The baseline advertisement does not include LCA information (NOLCA) in a textual format (TEX)

Table 4 Regression results of all dependent variables in the B2B study

	Standardized coefficient estimates (n=1,062)					
	COM	CRE	AAD	ABR	ACO	PI
Independent variables						
Intercept term[a]	4.082*	3.869*	3.358*	2.091*	2.077*	–0.471*
Elaborated functional (ELFU)	0.214	–0.022	0.018	–0.084	0.057	0.125
General environmental (GEN)	0.201	–0.206*	–0.024	–0.035	–0.079	0.172*
Elaborated environmental (ELEN)	0.078	0.244*	0.239*	–0.039	0.046	0.115*
Private financial (PFI)	0.171	–0.034	0.068	–0.028	–0.014	0.010
Private health (PHE)	0.20**	0.026	–0.035	0.033	0.096*	–0.112**
Complexity (COM)	–	–	–0.321*	–0.035	–0.004	–0.078*
Credibility (CRE)	–	–	0.349*	0.149*	0.320*	0.256*
Attitude toward the ad (AAD	–	–	–	0.356*	0.121*	0.168*
Attitude toward the brand (ABR)	–	–	–	–	–	0.186*
Attitude toward company (ACO)	–	–	–	–	–	0.348*
Control variables						
Gender (GEN)	0.099	–0.004	–0.080	–0.054	0.019	–0.072
Product knowledge (KNO)	0.002	–0.077*	0.029	–0.049	–0.037*	0.051**
Energy star familiarity (STA)	0.060	0.037	–0.017	0.065	0.039**	0.024
Environmental concern (EC)	0.071**	0.019	0.001	–0.054	0.013	0.062*
Processing effort (ATT)	–0.320*	–0.004	0.113*	0.005	–0.048*	0.014
Professional experience (EXP)	0.007	–0.014*	–0.009*	–0.004	–0.005*	–0.008*
Attitude toward advertising (ADV)	–0.100*	0.319*	0.099*	0.078*	0.073*	0.061*
Adj. R^2	0.0958	0.1548	0.3628	0.2828	0.4508	0.5468

*$p \leq 0.05$ (significant)
**$p \leq 0.10$ (significant)
[a] The baseline advertisement includes a general functional disclosure (GFU) with a functional private benefit disclosure (PFU)

the credibility of the ad (CRE), in fact, it is negatively influenced (–0.206; p value=0.001). However, when elaborated LCA information (ELEN) is presented (i.e. shown with quantitative and specific environmental impact results), a significantly positive effect is created toward CRE, AAD, and PI of the product under evaluation. Although we anticipated that this could occur for all types of elaborated messages, this was not the case with those ads which only included functional performance information (ELFU); none of the coefficients of our dependent communication effectiveness variables showed significant effects by simply elaborating on functional attributes. In other words, this is not simply a volume effect of more information leads to improved attitudes. The effect in this case is isolated to elaborated environmental performance information. One possible explanation to these results is that our experienced respondents (i.e. 58% of total respondents have more than 10 years of professional experience) already know enough about the functional performance of these products in general, that the additional details don't make much of a difference. Nevertheless, as we have anticipated, environmental arguments are often viewed with less understanding and with higher skepticism, thus the additional disaggregated information provides enough substantiation to make the ad more credible (0.244; p value=0.001), more favorable (0.239; p value= 0.001), and positively influence the purchase intention (0.115; p value=0.001).

4.2.2 The effects of LCA-based claims on ad effectiveness

We did not find support for the hypothesis that including a private environmental benefit disclosure increases the communication effectiveness over messages with only a public benefits. That is, the inclusion of an additional financial (PFI) or health (PHE) private benefit disclosure did not create any significant effect over messages with a product functional performance statement (PFU), nor were significant differences detected among complexity, credibility, attitudes, or purchase intention between the ads. We acknowledge that our respondents are not the private receivers of the product benefits, but as business buyers, they appear to have processed the information with little interest in benefiting their clients. One could counter argue that a builder/architect could potentially obtain higher margins by means of a higher price or lower transaction cost if the end consumer is able to save some money; however, in either case, this potential benefit is not seen as obviously tangible by architects and engineers included in the study.

The two constructs (complexity and credibility) had significant influence on the communication effectiveness measures. The complexity (COM) of the message negatively influences the attitude of the advertisement (–0.321; p value=0.001) and its purchase intention (–0.078; p value=0.001), although attitudes toward the brand (ABR) and the company (ACO) were not affected in a significant manner. On the other hand, the perceived credibility (CRE) of the information presented in the ad had a significant positive effect on all the communication effectiveness measures (i.e. AAD, ABR, ACO and PI). The magnitude of these positive coefficients also tends to indicate that improvements in credibility may compensate for the negative impacts of complexity to the extent that the additional information is justified.

5 Discussion

It is evident from the results of both empirical tests, first, in a business-to-consumer setting and later in a business-to-business, one, that the inclusion of LCA-based information in advertisements doesn't appear to negatively influence most variables typically used to assess advertising effectiveness; however, the appeal of the advertisement itself is significantly negatively impacted by increases in complexity. That is, within the context of this study, as the perceived complexity of the message increases, the favorability toward the advertisement itself decreases—while the brand, company, and purchase intent often gain favor as a result of higher levels of message credibility.

Beyond these broad findings, there are interesting differences between the experiments. Within the B2C respondents, we found that the perceived complexity of the ad in fact generated a significantly positive attitudinal response concerning the company under evaluation, which was not evident in the B2B study. Here, attitudinal responses toward the brand (ABR) and the company (ACO) were not influenced by the perceived level of complexity (COM). One possible reason for this variation is that individuals in the B2B study are more experienced in the product category and in this particular case more familiar with 'green building' and the product category's environmental attributes. Ultimately, and as expected, the elaboration level within this group allowed for greater message complexity without significantly affecting attitudes toward the product or company; however, this level also precludes the immediate formulation of positive associations of information disclosure and the firm or product. One might argue that students are also experienced shampoo buyers; nevertheless, the act of buying shampoo for many is fairly low involvement (i.e. they don't know much about the performance—particularly non-functional performance—of their current supplier) and their unfamiliarity with biodegradable plastic bottle technologies allows for positive associations to emerge simply based on the additional information, whether it is fully understood or not. In other words, the results suggest that the end-use consumers in the first experiment more often processed the ad through the peripheral route of persuasion, where the downside risk of presenting complex and detailed environmental information is significant (i.e. people won't pay attention to the ad), but can be balanced (or even surpassed) by positive associations with presenting additional information (i.e. the company must be strong if it is willing to fully disclose all of this information).

6 Conclusions

Although practitioners should recognize simple messages are often required to gain market awareness and break through the noisy hypermedia marketplace, the overall purchase behavior is influenced by other factors beyond the appeal of the ad itself. Thus, when it comes to environmental performance information, keeping it simple may maintain ad appeal but negatively impacts other factors influencing purchase behavior. We found that the attitudinal response of buyers toward the brand and the company were not influenced by their perceived level of message complexity. Results from the business-to-consumer test indicate that it is likely that more complex messages make for poor advertising. However, its negative effect seems to stop at this level and doesn't affect the attitudes toward the brand, toward the company, and purchase intentions. In contrast, credibility, gained through explicit LCA-based environmental disclosures, favorably influences the perceptions toward the company and the brand. These results are similar in the business-to-business environment, although the effects of complexity and credibility on these two variables are less pronounced. It is evident in this business setting of environmental and energy sensitive business buyers that advertisements with environmental messages are more effective than those presenting functional product benefits alone, but only when the messages are substantiated with quantitative and disaggregated information—resulting from the inclusion of LCA-based information. In both samples, the credibility gained through more elaborated environmental messages, to a high extent, compensates for the effects of complexity. In fact, improved credibility strongly influences in a positive manner the attitudes buyers have toward the ad, the brand, the company, and their intention to purchase the products under evaluation.

In summary, it appears that when companies intend to communicate environmental (non-functional) messages, the inclusion of elaborated LCA information is appropriate.

These results are of particular importance today when brand image is considered an important asset to companies. With an increasing pressure from multiple stakeholders toward environmental and social responsible activities, the credibility gained with these less appealing ads might be, in the long term, a fruitful approach.

7 Recommendations and perspectives

If environmental performance information can generate positive effects when their claims are elaborated, a new set of implications arise for researchers, LCA practitioners, managers, and policy makers? First, in light of the research findings, practitioners are to reconsider the common position that less appealing advertisements are damageable to the overall marketing communication strategy. Simple messages are often required to gain market awareness and break through the noisy hypermedia marketplace; nevertheless, the benefits of a strong brand, positive firm image, and even intentions to purchase are influenced by factors well beyond the appeal of advertisements themselves. Particularly with regard to environmental performance information, credibility must also be managed and the improved utilization of LCA-based information may be one such tool at a firm's disposal.

For researchers interested in further exploring these ideas, we forward several potential venues. A more detailed analysis of the life cycle stages is an aspect worthy of further exploration in the development of credible environmental communications. It would be useful to understand at which stage(s) of the product life cycle are product environmental benefits most connected with communication effectiveness. Although we have forwarded the assertion that a more comprehensive provision of environmental performance information is helpful in improving the credibility of claims, this effect may vary based on the particular life cycle stage. If the main benefit is closely related with the use phase of the product—energy savings or improved human health, for example, greater interest in product benefits within this phase may result in higher thresholds of acceptable complexity. In a similar fashion, improved understanding of the role of varying environmental impact categories (greenhouse gas emissions, toxic releases, resource efficiency, etc.) in developing effective environmental performance communications is very much needed. Finally, despite the consistency found in the two business settings explored, one might want to explore the relationships in other regional areas or with other segments in the market. As one of the first studies on this specific area, we were methodologically careful on the minimization of influences by extraneous variables, often present in less homogeneous populations (Calder et al. 1981).

Researchers and practitioners developing LCA methods and protocols must also recognize the potential benefits and costs associated with reporting partial and selected data stemming from LCA efforts. While significant debate remains with regard to standard LCA reporting criteria, advertising will most likely continue as a mechanism by which firms present their products and services in the best possible light. This includes communications based on accurate, non-deceptive, though incomplete, information. Particularly given the evidence that end-use consumers may not directly process additional LCA-based information, but generate favorable associations with firm providing this additional information, LCA researchers and practitioners play an important role in creating appropriate standards and certifications associated with these techniques. Without such initiatives, the ability of LCA in providing credibility to marketing claims may be diminished.

Finally, from a public-policy point of view, the findings uncovered here indicate that elaborated environmental information is to be encouraged to avoid potentially deceptive advertisements, better informing consumers and buyers, and also protecting corporate reputation. Furthermore, it is important to examine the mix of several environmental disclosure types, such as, mandatory labels, third-party certified ecolabels, and self-declared claims. One might think of a scenario where products/processes of industry sectors with higher environmental risk would be selected to mandatory information disclosures and those with less risk could implement voluntary environmental disclosures (certified or not).

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